

STUDIES OF DIFFERENT IRRIGATION SCHEDULES AND VARIETIES ON GROWTH, YIELD AND ECONOMICS OF SUMMER SEASON GUAR OR CLUSTERBEAN (*CYAMOPSIS TETRAGONOLOBA* L.) IN MIDDLE GUJARAT CONDITION, INDIA

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ABSTRACT

A field experiment was conducted during 2012 at Gujarat to study the varietal response of summer cluster bean (*Cymopsistetragonoloba* L.) to different irrigation scheduling (IW: CPE ratios) under middle Gujarat conditions. The field experiment was laid out in strip plot design with four replications. Irrigation applied at (I_2) 0.8 IW: CPE ratio (Common irrigation + 7) had pronounced effect on plant height (32.63, 43.48 and 75.23 cm) at (30, 60 and 90 DAS), respectively, the highest seed (1489 kg ha⁻¹), gotar yield (4325 kg ha⁻¹) and treatment cost (2490 ₹) compare than other irrigation scheduling as (I_0) Control (critical growth stage as Branching, Flowering and Pod formation) (Common irrigation + 3) total four irrigation, (I_1) 0.6 IW: CPE ratio (Common irrigation + 6) total seven irrigation and (I_3) 1.0 IW: CPE ratio (Common irrigation + 8) total nine irrigation. PusaNavbahar (PNB) recorded the maximum plant height (30.95, 41.59 and 81.28 cm) at (30, 60 and 90 DAS) respectively, the highest seed (1429 kg ha⁻¹), guitar yield (4076 kg ha⁻¹) and treatment cost (4620 ₹) than the others. The maximum percent of soil moisture was extracted from 0-15 cm soil depth, followed by 15-30 cm soil depth for all the treatments of irrigation.

KEYWORDS: Irrigation Scheduling, Summer Cluster Bean, Gujarat, Varieties & Moisture Extraction

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INTRODUCTION

It can be grown successfully on marginal lands and in areas of erratic rainfall. Amongst the legume crops, cluster bean is grown for fodder, vegetable, and cattle feed. It has now assumed great significance with increasing demand for high-quality gum, which is present in its seed endosperm. After extracting gum from the seed endosperm, the residual byproduct of cluster bean rich in protein serves as cattle feed. Despite poor fertility of soils, very little research efforts have gone into the agronomic aspects influencing its production. Therefore, the present investigation was undertaken to identify suitable variety and irrigation scheduling.

Cluster bean (*Cyamopsistetragonoloba* L.) is an important crop locally known as 'Guar' grown for green tender pods and for extraction of gum from seeds. Due to more remunerative market prices for last few years, the farmers of Gujarat have shown more interest in this crop. Cluster bean (vegetable) crop requires irrigation for continuous flowering, ultimately, higher production of green pods. Its low productivity is mainly due to inadequate

nutrition and management practices. In arid and semi-arid areas of Gujarat, the problem is more aggravated due to very limited availability of irrigation water, particularly in the summer season [1].

As water for irrigation is a scarce resource, its optimization is fundamental to water resource use. It permits better utilization of all other production factors and thus leads to increased yields per unit area and time. The objective of irrigation is to maintain the soil moisture at optimum levels in the plant root zone, so that root will have a constant supply of moisture with adequate aeration. Efficient water management requires a thorough study of the plant water relationship, climate, agronomic practices and economic assessment [2].

When promising genotypes with higher yield potential identified, it is necessary to establish their appropriate agronomic manipulation or cultivation practices obtaining higher yield. A plant population is one of such factors that have direct influence on the yield of a particular genotype. In recent years, the cluster bean seeds are used in industries for its vegetable gum, which has a great demand. Cluster bean gum and its derivatives are widely used in several industries such as food processing, mining, paper, textiles, ceramics, paints, cosmetics, oil industries and pharmaceuticals. Cluster bean by product of gum industry is also used as concentrate feed for the animal. Seeds are used as a chemotherapeutic agent against smallpox and also used as laxative [2].

Use of improved varieties of cluster bean in addition to adequate irrigation scheduling management has been reported effective in improving the productivity of cluster bean in arid zone. Though the captives have their own inherent ability for growth, development and yield, yet some genotypes of cluster bean have shown considerable variation in yield potentials under varying fertility levels [3]. Keeping in view, the scanty information available on these aspects, present investigation entitled, studies on the performance of different irrigation schedules and varieties on growth, yield and economics of the summer season guar (*Cyamopsistetragonoloba* L.) in middle Gujarat condition, India has been planned to be carried out.

MATERIALS AND METHODS

Experimental Site, Climate and Soil

This field experiment was conducted during the summer season of the year 2012 in the plot No. 32 of the College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, (Gujarat).

The geographical coordinates of Allahabad are 22° 35' N latitude and 72° 35' E longitude, with an elevation of 45.1 m above the mean sea level. The climate of Anand is semi-arid and sub-tropical. In this area monsoon commences by the third week of June and retreats by the middle of September with an average rainfall of 864 to 870 mm received entirely from the southwest monsoon current. Uncertain and uneven distribution of rainfall in the monsoon in Anand district. All the facilities required for crop cultivation are available. The data regarding daily pan evaporation measured from USWB class "A" pan evaporimeter during the experimental period [4].

The soil was representative of the soil of the region, locally known as Goradu soil. The texture of the soil was loamy sand. It is alluvial in origin, light brown in color, well drained, fairly retentive of moisture, low in organic matter and responded well to manuring and irrigation.

The soil is experimental plot was sandy loam in texture having a pH of 8.60 by pH meter [6] with low level of organic carbon 0.45 % by Walkley and Black method [5], low level of available N ($242.32 \text{ kg ha}^{-1}$) by alkaline permanganate method, [6] available medium level of P (24.53 kg ha^{-1}) by Olsen's method. [7] and medium level of K ($188.28 \text{ kg ha}^{-1}$) by

Flame photometric method Jackson [5]. The experiment was laid out randomized block design, comprising of sixteen treatment combinations each replicated thrice.

The experiment consisted four irrigation treatments in vertical strip as IW: CPE ratio (0.6, 0.8 and 1.0 kg ha⁻¹) and control (critical growth stage as Branching, Flowering and Pod formation) and three varieties of cluster bean (Gujarat Guar – 1 (GG-1), Gujarat Guar – 2 (GG-2) and Pusa Navbahar (PNB)) in horizontal strip of strip plot design.

Soil Moisture Studies

The soil moisture studies were started right from the sowing of the crop and continued up to its maturity. The soil moisture content of all the treatments in one replication was determined on the same day just before irrigation and 48 hours after irrigation at 0-15, 15-30, 30-45 and 45-60 cm soil depths were recorded.

Soil samples were taken with the help of the screw auger from four different depths (0-15 cm, 15-30 cm, 30-45 cm and 45-60 cm). The soil samples were taken around fixed spot selected at random in net plot area of each treatment from one replication. The samples were transferred immediately to aluminum boxes and covered with a moist gunny bag to avoid moisture losses from the samples. The samples were shifted immediately to the laboratory. The value of table 'F' at 5% level significance, where the treatment difference between were found significant the value of the CD and CV % were also worked out to compare the treatment mean Snedecor and Cochran [8].

RESULTS AND DISCUSSION

Effect of Different Irrigation Scheduling

Data presented at (Table-1) plant height (32.63 cm) at 30 DAS significantly higher in irrigation treatment (I₂) 0.8 IW: CPE ratio (Common irrigation + 7) = 8. However, at par with treatment (I₁) 0.6 IW: CPE ratio (Common irrigation + 6) = 7 and (I₃) 1.0 IW: CPE ratio (Common irrigation + 8) = 9.

At 60 DAS, significantly the highest value of plant height (43.48 cm) in irrigation treatment (I₂) 0.8 IW: CPE ratio (Common irrigation + 7) = 8. While plant height (75.23 cm) was observed value significantly higher at 90 DAS with at par with (I₃) 1.0 IW: CPE ratio (Common irrigation + 8) = 9. High values of growth parameters at higher moisture regimes might be due to the application of more irrigations as timely and early growth stages encourage better growth and development [9].

The second reason might be owing to increase in moisture regimes resulted in higher photosynthetic activity per unit area and more dry-matter production lead to increase in growth indices.

Table 1: Effect of Irrigation Scheduling and Varieties on Plant Height, Seed Yield, Gotar Yield, Total Common Cost and Treatment Cost of (*Cymopsistetragonoloba* L.)

Treatments	Plant height (cm)			Seed Yield (kg ha ⁻¹)	Gotar Yield (kg ha ⁻¹)	Total Common Cost (₹ ha ⁻¹)	Treatment Cost (₹ ha ⁻¹)
	At 30 DAS	At 60 DAS	At 90 DAS				
Vertical strip (Irrigation IW:CPE ratio) (I-4)							
I ₀ : Control (critical growth stage as Branching, Flowering and Pod formation) (Common irrigation + 3) = 4	22.03	35.24	68.64	1370	3776	27732	1240

Table 1: Contd.,							
I_1 : 0.6 IW: CPE ratio(Common irrigation + 6) = 7	30.79	37.73	69.50	1297	3858	27732	1990
I_2 : 0.8 IW: CPE ratio(Common irrigation + 7) = 8	32.63	43.48	75.23	1489	4325	27732	2240
I_3 : 1.0 IW: CPE ratio(Common irrigation + 8) = 9	30.38	37.79	73.70	1318	3725	27732	2490
<i>S. Em</i> ±	0.93	1.67	1.40	37.57	70.82	-	-
<i>C. D.</i> at 5 %	2.98	5.35	4.47	118	227	-	-
<i>C.V.</i> (%)	11.15	15.02	6.75	9.51	6.26	-	-
Horizontal strip (Variety (V-3))						-	-
V_1 : Gujarat Guar – 1 (GG-1)	25.62	36.08	66.90	1290	3731	27732	3870
V_2 : Gujarat Guar – 2 (GG-2)	30.30	38.00	67.12	1386	3956	27732	3870
V_3 : PusaNavbahar (PNB)	30.95	41.59	81.28	1429	4076	27732	4620
<i>S.Em</i> ±	1.14	1.19	3.02	30.91	52.79	-	-
<i>C. D.</i> at 5 %	3.95	4.13	10.45	107	183	-	-
<i>C.V.</i> (%)	15.77	12.38	16.83	9.04	5.39	-	-
Interaction $I \times V$	NS	NS	NS	S	NS	-	-
<i>C.V.</i> (%)	11.14	9.88	6.66	6.53	5.26	-	-

The results indicated that treatment (Table-1) the effect of different levels of irrigation scheduling and varieties on the significantly the highest value recorded in treatment (I_2) 0.8 IW: CPE ratio (Common irrigation + 7) = 8. viz., Grain yield (1489 kg ha⁻¹), Gotar yield (4325 kg ha⁻¹). The probable reason might be due to attributed to its beneficial effect on the better development of yield attributes at higher moisture regimes might be owing to increase in cell turgidity, a better opening of stomata and finally helping in translocation of photosynthates to sink [9], [10]. The increase in guitar yield due to various treatments may be mainly due to increase in the vegetative growth characters. [4].

The data pertaining to economics in (Table-1) indicated that the highest treatment cost (2490 ₹) was secured under treatment (I_2) 0.8 IW: CPE ratio (Common irrigation + 7) = 8 respectively, While the lowest (1240 ₹) was observed under irrigation scheduling (I_0) Control (critical growth stage as Branching, Flowering, and Pod formation) (Common irrigation + 3) = 4, respectively.

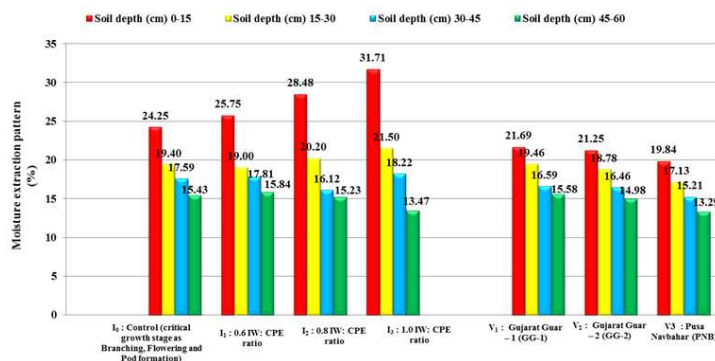


Figure 1: Effect of Irrigation Scheduling (IW: CPE Ratios) and Varieties on Moisture Extraction Pattern (%) of Cluster Bean (*Cymopsistetragonoloba* L.)

The data indicated (Figure 1) that the soil moisture extracted from 0-15, 15-30, 30-45, and 45-60 cm of soil depth were 24.25, 19.40, 17.59 and 15.43 percent under treatment (I_0) (Control, at critical growth stages Branching, Flowering and Pod formation, 25.75, 19.00, 17.81 and 15.84 percent under treatment (I_1) 0.6 IW:CPE ratio, 28.48, 20.20, 16.12 and 15.23 percent under treatment (I_2) 0.8 IW:CPE ratio and 31.71, 21.50, 18.22 and 13.47 percent under treatment (I_3) 1.0 IW:CPE ratio. The maximum percent of soil moisture was extracted from 0-15 cm soil depth, followed by 15-30 cm soil depth for all the treatments of irrigation. The moisture extraction increased with the increase in quantity of irrigation water from upper layers of soil (0-15 and 15-30 cm soil depth), whereas, the almost reverse trend was observed with respect to deeper layers of soil (30-45 and 45-60 cm soil depth) under the study.

Effect of Different Varieties

Among the cluster bean varieties (Table-1) at 30 and 60 DAS recorded significantly the higher plant height (30.95 and 41.59 cm) in a variety (V_3) PusaNavbahar (PNB) than other both varieties. It variety also have related significantly at par with (V_2) Gujarat Guar – 2 (GG-2). However, at 90 DAS significantly the highest plant height (81.28 cm). It might be due to the differential behavior of cluster bean varieties with respect to root-shoot growth characters could be explained solely by the variation in their genetic make-up and adaptability to soil and climatic conditions. The results are in close conformity with the findings of [12] whom reported that the late genotypes had better vegetative growth in terms of plant height [4].

The perusal of the data presented in (Table 1) reveals that the variety (V_3) PusaNavbahar (PNB) recorded significantly the higher seed (1429.00 kg ha⁻¹) and greater yield (4076.00 kg ha⁻¹). However, it significantly at par with variety (V_2) Gujarat Guar – 2 (GG-2) value seed (1386.00 kg ha⁻¹) and greater yield (3956.00 kg ha⁻¹). It might be due to the trend of increases in seed and guitar yields obtained due to these treatments was exactly in accordance with the similar increase in the yield attributing characters [13]. The second reason might be ascribed to their best vegetative growth in terms of plant height, number of pods, and bolder seeds.

The seed yield is the resultant of the coordinated interplay of growth and development characters. Thus, the productivity parameters are based on the cumulative effect of the genetic ability and production efficiency of the varieties, their fertility management and the agro-climatic conditions where these varieties are grown. The wide variations in productivity parameters among the cluster bean varieties have also been observed by [14] and [15]

The data pertaining to economics in (Table-1) indicated that the highest treatment cost (4620 ₹) was secured under treatment (V_3) (PusaNavbahar) respectively, While the lowest (3870 ₹) was observed under both varieties (V_1) (Guj-Guar-1) and (V_2) Gujarat Guar – 2 (GG-2) respectively.

The data indicated (Figure 1) that the moisture extracted from 0-15, 15-30, 30-45, and 45-60 cm of soil depth were 21.69, 19.46, 16.59 and 15.58 percent observed under treatment V_1 (Guj-Guar-1) and 21.25, 18.78, 16.46, and 14.98 percent under treatment (V_2) (Guj-Guar-2) and 19.84, 17.13, 15.21 and 13.29 percent in treatment (V_3) (PusaNavbahar). The maximum percent of moisture was extracted by treatment (V_1) (Guj-Guar-1, followed by (V_2) (Guj-Guar-2). Whereas lower soil moisture was observed deeper layers of soil (30-45 and 45-60 cm).

CONCLUSIONS

From the present investigation, it may be concluded that adoption of irrigation at IW: CPE of 0.80 in cluster bean with either use of cv. PusaNavabahar (PNB) or Gujarat Guar -2 varieties leads to increase in growth parameters along with

yield parameters and seed and guitar yields compared to others. Since varied weather conditions, the crop seasons of cluster bean have performed well productivity from irrigation scheduling and varieties.

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REFERENCES

1. Patel, S. J., Patel, B. M., Raval, C. H., Patel, K. I., Patel, P. B., Patel P. M. and Vekaria, L. C. 2014. Response of vegetable clusterbean (*Cyamopsistetragonoloba* L.) to fertigation of p and k. *Legume Res.*, 37 (4): 420-423,
2. Anonymous, 2008. Commodity profile of guar seed by ICEX and CRN India and Department of agriculture. Report on guar seed.
3. Rawat, Upama ., Rajput, R. L., Rawat G. S., and Garg S. K. 2015. Effect of varieties and nutrient management on growth, yield and economics of clusterbean (*Cyamopsistetragonoloba* L.).*Res. on Crops* 16 (1): 64-67.
4. Deewan, Parvati. 2010. Influence of irrigation scheduling (IW:CPE Ratios and plant growth regulators on growth and green pod yield of summer cluster bean (*Cymopsistetragonoloba* L.) thesis A.A.U. Gujarat.,
5. Jackson, M. L. 1973. Soil chemical analysis prentice hall of India Pvt. Ltd., New Delhi, pp. 183-192.
6. Subbiah, B. V. and Asija, G. C. 1956. A rapid procedure for the estimation of available nitrogen in soil.*Curr.Sci.* 25:259-260
7. Olsen, S. R. (1954). Estimation of available phosphorus in soilby extraction with sodium hydrogen carbonate,U.S.D.A. Circ. 939: 19
8. Snedecor, G. W. and Cochran, W. G. 1967. "Statistical method". The IOWA state University Press, IOWA.
9. Rajanna, G. A., Dhindwal A. S. and Sriharsha V. P. 2016. Performance of clusterbean (*Cyamopsistetragonoloba* L.) under variable irrigation schedules and crop-establishment techniques. *Indian Journal of Agronomy* 61 (2): 223-230. [11] Sewhag, M., Phogat, V. K., Dhindwal, A. S. and Hooda, I. S. 2008. Influence of planting methods and moisture regimes on yield and yield attributes of clusterbean (*Cyamopsistetragonoloba* L.). *Annals of Agriculture Biology Research* 13(2): 127-131.
10. Sewhag, M., Phogat, V.K., Dhindwal, A.S. and Hooda, I.S. 2008. Influence of planting methods and moisture regimes on yield and yield attributes of clusterbean(*Cyamopsistetragonoloba*). *Annals of Agriculture Biology Research* 13(2): 127-131.
11. Rawat, Upama ., Rajput, R. L., RawatG. S., and Garg S. K. (2015) Effect of varieties and nutrient management on growth, yield and economics of clusterbean(*Cyamopsistetragonoloba*L.).*Res. on Crops* 16 (1): 64-67.
12. Vyas, S. P. 2002. Response of early and late clusterbean genotypes under field droughts at Bhuj. *National Symposium on Arid Legumes for Food, Nutrition Security and Promotion of Trade*, May 15-16. pp. 116-17.
13. Kalyani, D., Lakshmi and Sunitha, N. 2011.Response of clusterbean (*Cyamopistetragonoloba* L.) varieties to different times of sowing – A review.*Agric. Rev.* 32: 209-15.
14. Singh, Yogendra, Singh, Praveen, Sharma, R. D., Marko, G. S. and Namdeo, K. N. 2013.Effect of organic sources of nutrients on growth, yield and quality of lentil genotypes. *Ann. Plant and Soil Res.* 15: (Accepted).